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H2H HBCA HBCH H25Q
H4L LECTX
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(56) Documents Cited
GB 1180168 A EP 0357829 A1 EP 0298707 A2
JP 040217824 A SE 920000554 A US 5396538 A

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(54) Abstract Title
Inductively coupled battery charger

(57) A battery charger 1 and a radio communication device 2, such as a radio telephone, may be removable couplable in an electrically noncontacting state with respect to one another so that a primary winding 103 in the charger 1 is coupled to a secondary winding 212 in the radio 2 to induce a current into the secondary 212 for charging a battery 210 in the radio. A charging halt signal may be generated in the radio 1 in response to an incoming call or in response to the user pushing specified keys on a keyboard 203. The halt signal is transmitted from the radio to the charger via an optical link 213, 107 to cause the charger to turn off the current in the primary winding 103. The radio 2 can then be removed from the charger 2 with a minimum of effort since there is then no electromagnetic attraction between the windings 103 and 212. A manually operated switch 106 in the charger may be provided to turn off the current in primary 103, or the switch 106 in the charger may be arranged to be turned on when the radio 2 is placed in a depression (102, Fig. 1) in the charger, a slight tilting of the radio 2 within the depression (102) causing the switch 106 to turn off when it is required to remove the radio from the charger.

Fig. 2

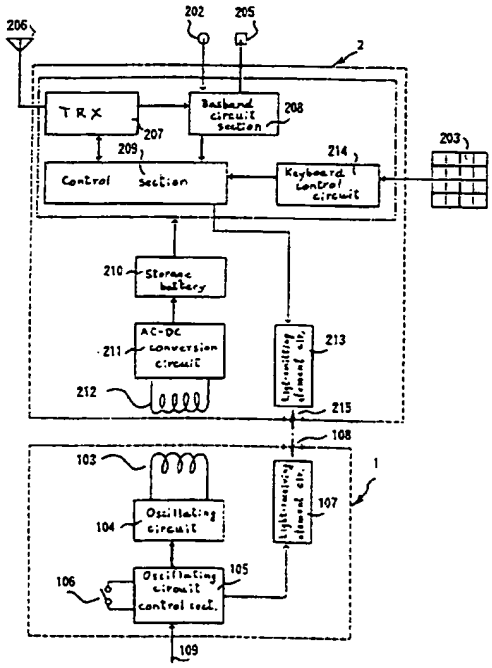

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FIG. 1

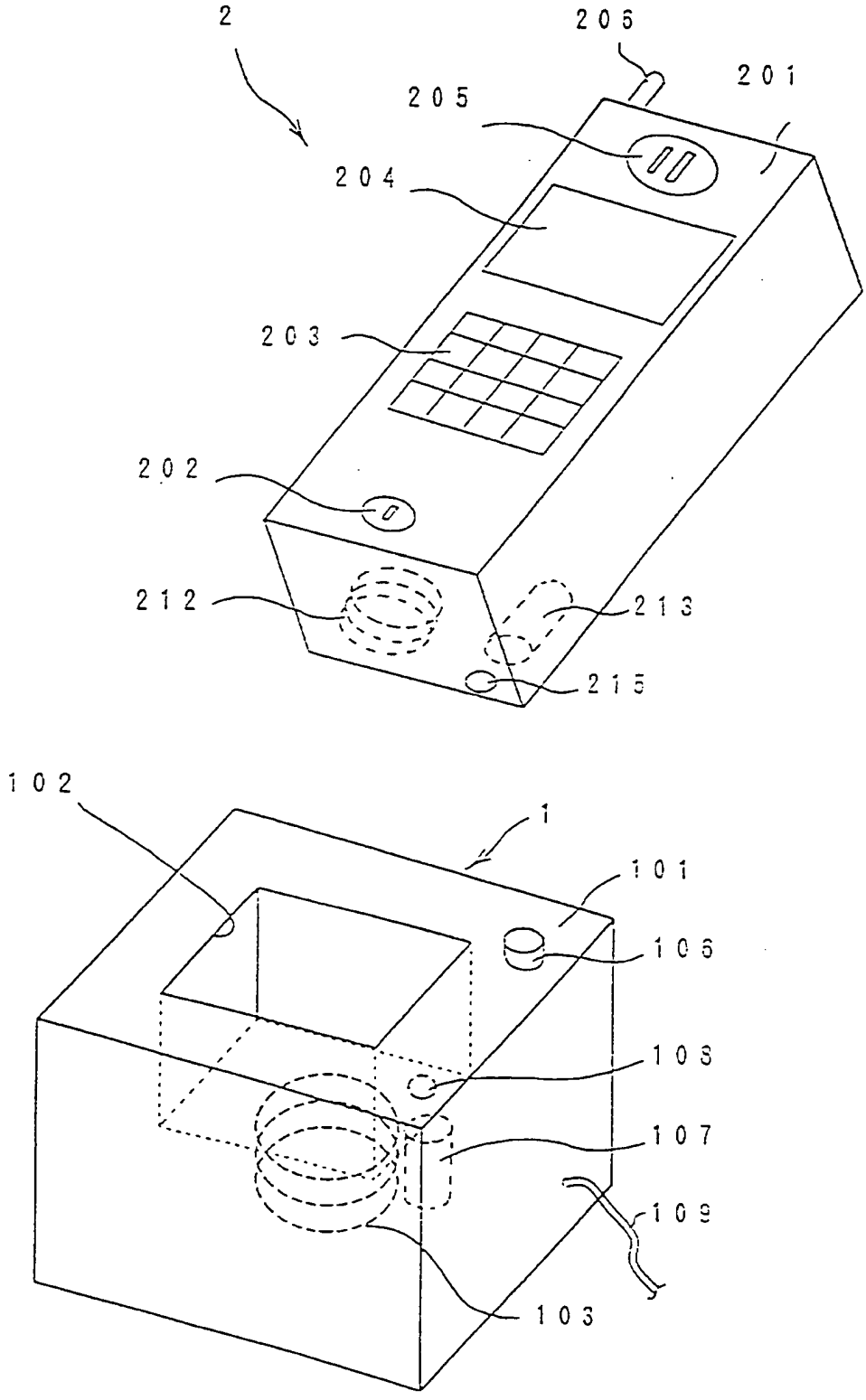
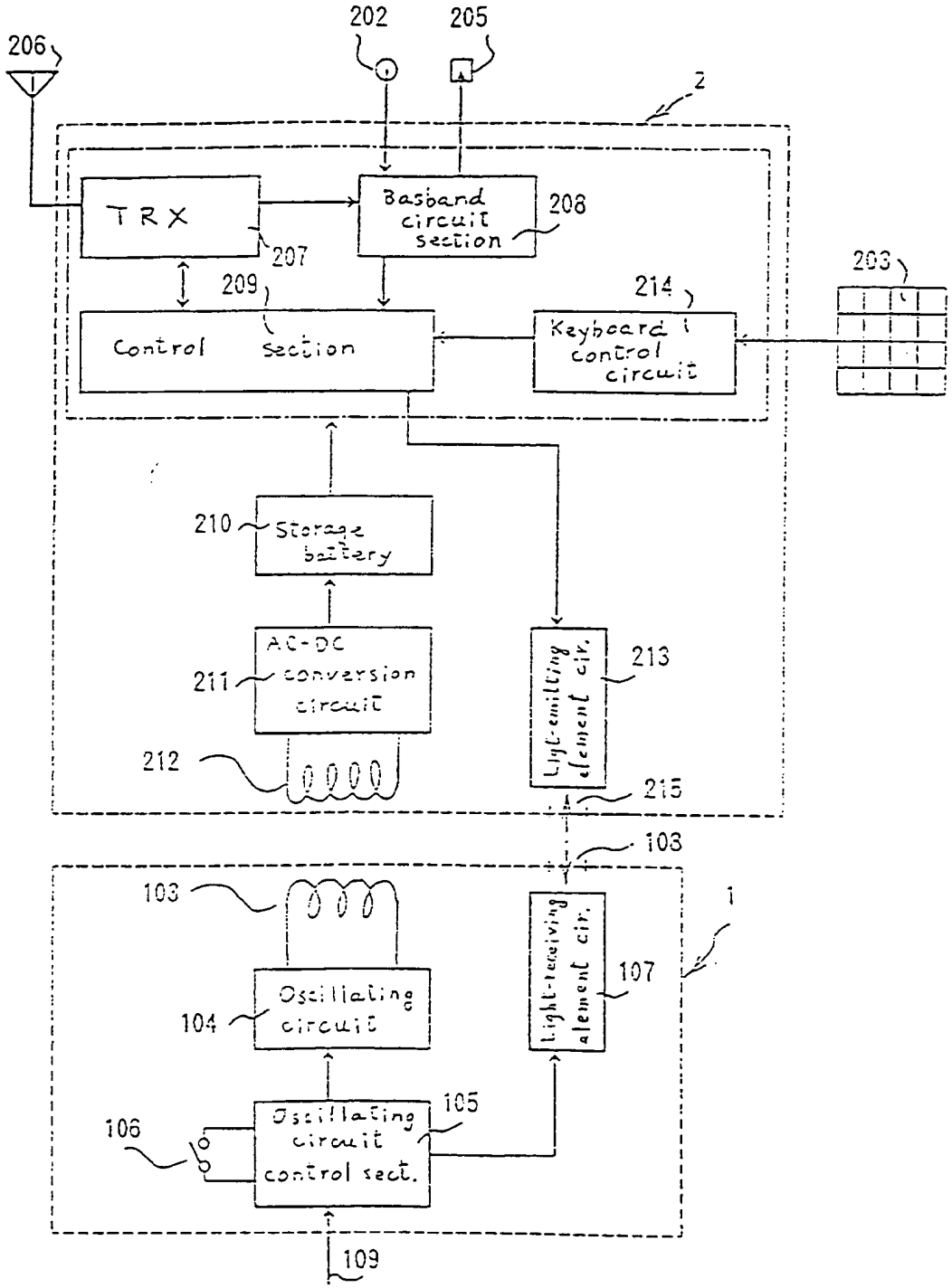

2
206
201
205
204
203
202
212
213
215
102
1
101
106
108
107
109
103

FIG. 2


202
205
206
2
TRX
207
Baseband circuit section
208
209
Control section
214
Keyboard control circuit
203
210
Storage battery
AC-DC conversion circuit
211
212
Light-emitting element cir.
213
215
103
103
Oscillating circuit
104
Light-receiving element cir.
107
1
Oscillating circuit control sect.
105
106
109

Noncontacting Charging Device

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates to a charging device for a radio communication device, and particularly to a charging device for charging, in an electrically non-contacting state, a radio communication device such as a storage-battery-equipped radiotelephone.

2. Description of the Related Art:

Charging devices have been suggested in recent years for charging chargeable storage batteries installed in radio communication devices such as radiotelephones that are capable of charging without being electrically connected to the radiotelephone. One example of such a device is a noncontacting charging device disclosed in Japanese Patent Laid-open 280631/90. In this charging device, a battery charger is provided with a primary coil to which an alternating current signal is supplied, while a radiotelephone is provided with a secondary coil which couples electromagnetically with the primary coil and which is connected to a charging circuit for a storage battery. By bringing the radiotelephone into proximity with the charger and supplying the primary coil with alternating current of prescribed voltage and frequency, an induced

electromotive force is generated in the secondary coil to serve to charge the storage battery of the radio-telephone.

In this charging device of the prior art, as the mutual induction coefficient between the primary and secondary coils is increased to raise an efficiency of an electric power supply to the storage battery of the radiotelephone, the electromagnetic attraction working between the two coils increase nearly in proportion to the mutual induction coefficient. This attractive force, however, adversely makes it difficult to lift lightly the radiotelephone from charger when it is necessary to make a call or to receive an incoming call during charging.

In such a case, charging is stopped in a charger of the prior art by pulling the power cord for an external power source connected to the charger from the commercial power socket. This necessity to pull the cord when lifting the radiotelephone from the charger is a nuisance, particularly when the radio telephone must be picked up quickly to receive an incoming call while using the charging device. However, if the power of the charger is decreased in order to weaken the electromagnetic attraction between the coils to circum-vent this problem, there is the problem that power supplied to the storage battery of the radiotelephone

also decreases, causing charging efficiency to drop, and making rapid charging impossible.

SUMMARY OF THE INVENTION

The invention is defined in the appendant independent claims, to which reference should now be made. Preferred features of the invention are defined in dependent sub-claims.

Advantageously, the present invention may thus provide a noncontacting charging device which has high charging efficiency and which moreover allows easy removal of the radio communication device from the charger, should it be needed for use such as to make or receive a call during charging.

In addition, the present invention may advantageously provide a noncontacting charging device that allows easy connection or disconnection between the radiotelephone and charger.

In a particularly preferred embodiments, the non-contacting charging device of the present invention provides a charging device for supplying, in a noncontacting state, electrical power to a storage battery of a battery-equipped radio communication device, comprising a charger having a primary coil and alternating current supply means for supplying alternating current power to the primary coil; a secondary coil that couples electromagnetically with the primary coil, and charging-power supply means for supplying, as charging power, electrical power of the induced current produced in the secondary coil to the storage battery; halt

signal generating means for generating a halt signal that commands a halt of the supply of alternating current power to the primary coil; and halting means for halting the supply of alternating current power to the primary coil in response to a halt signal; the secondary coil, charge power supply means, and halt signal generating means being provided in the radio communication device.

By means of this device, a halt signal is issued from the radio communication device. By means of this signal, charging may be halted through the operation effected on the side of the radio communication device when it is necessary to make or receive a call while charging the radio communication device, thereby eliminating the effect of electromagnetic attraction upon the radio communication device and enabling easy removal of the radio communication device from the charger. Consequently, the process of removing a radio communication device from a charger is made easy.

According to a preferable form of the halting means the radio communication device is provided with electrophoto converting means that converts the halt signal to an light signal and outputs it to the charger; and the charger is provided with photoelectric converting means that receives the light signal and converts it to an electrical signal, and cut-off

circuit means for cutting the path of power supply to the primary coil in response to the output of the photoelectric converting means.

Through this simple construction, the halt signal can be transmitted from the radio communication device side to the charger side without direct contact by means of an light signal.

The halt signal generating means can be made up of at least one console key for commanding a halt of the supply of alternating current power to the primary coil, and a first halt signal generating circuit for producing a halt signal in response to a signal generated by key input to this console key.

Further, the halt signal generating means may also include a second halt signal generating circuit for detecting an incoming call to the radio communication device and outputting a halt signal.

By means of this halt signal generating means, when a call must be originated or received during charging of the radio communication device, charging can be halted either through the operator's manipulation of the console key of the radio communication device or automatically when an incoming call is detected, and in this way the radio communication device may be lightly removed from the charger, thereby allowing easy use of the radio communication device.

As halting means, a switch for cutting the power supply path to the primary coil by manual operation may be provided in the charger. Charging may halted by manual operation of this switch.

The above and other objects, features, and advantages of the present invention will become apparent from the following description referring to the accompanying drawings which illustrate an example of a preferred embodiment of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exterior view showing the construction of one embodiment of a charging device of the present invention; and

Fig. 2 is a block diagram showing the internal construction of the charging device shown in Fig. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention will next be explained with reference to the accompanying figures.

Fig. 1 is an exterior perspective view showing one embodiment in which the noncontacting charging device of the present invention is applied to a radiotelephone. Fig. 2 is a block diagram illustrating the circuit construction of the device shown in Fig. 1. The charger 1 for supplying power for charging to the

radiotelephone is installed within a base case 101. A depression 102 into which the radiotelephone may be inserted is provided on the upper surface of the base case 101, and a primary coil 103 is provided in the base case 101 for producing magnetic flux which runs around the side walls of the depression 102 in a vertical plane. This primary coil 103 is connected to an oscillating circuit 104 for supplying alternating current to the coil. In addition, an oscillating circuit control section 105 is provided for supplying electrical power to this oscillating circuit 104. A manually operated switch 106 for turning on and off the power supplied to the oscillating circuit 104 is connected to the oscillating circuit control section 105. This switch 106 is provided in a portion of the upper surface of the base case 101.

Furthermore, the charger 1 is provided with a light-receiving element circuit 107. The light-receiving element circuit 107 is arranged facing a transparent window 108 provided in a portion of the depression 102, and in response to a light signal transmitted through the transparent window 108, outputs a signal for on/off controlling a power switch circuit (not shown) incorporated in the oscillating circuit control section 105. In the present embodiment, a photodiode is used as the light-receiving element

circuit, and a power cord 109 for supplying power from an external power source(not shown)to the oscillating circuit control section 105 is led out from the base case 101.

The radiotelephone 2 is provided with a microphone 202, a console keyboard 203, a display 204, a receiver 205, and an antenna 206 mounted on a slender telephone case 201. Inside the telephone case 201 are provided a known telephone speech network made up of a transmitter-receiver (TRX) 207, a baseband circuit section 208, a control section 209, and a keyboard control circuit 214, and as a power source, a storage battery 210. This storage battery 210 is connected to a secondary coil 212 by way of an AC-DC conversion circuit 211. In addition, a light-emitting element circuit 213 is connected to the control section 209. In the present embodiment, this light-emitting element circuit 213 is made up of a light-emitting diode. The console keyboard 203 and control section 209 are connected by way of keyboard control section 214.

The base of the telephone case 201 is constructed to allow insertion into the depression 102 provided in the base case 101, and in this way the radiotelephone 2 may be placed on the charger 1 in an erect state. The secondary coil 212 is provided within the base portion of the case 201 of the radiotelephone 2, and a

transparent window 215 is provided in the bottom surface and the light-emitting element circuit 213 is provided facing the window 215. Transparent windows 215 and 108 are arranged in face-to-face positions.

To operate, the radiotelephone 2 is placed upon the charger 1 when the storage battery 210 built into the radiotelephone 2 is to be charged. At this time, the radiotelephone 2 is held in an erect state by means of insertion of the base portion of the telephone case 201 of the radiotelephone 2 into the depression 102 provided in the base case 101 of the charger 1. The charger 1 is then connected by way of power cord 109 to an external power source not shown, and switch 106 is turned on. This causes, in the charger 1, the power controlled by oscillating circuit control section 105 to be supplied to the oscillating circuit 104. An alternating current signal of prescribed frequency generated in this oscillating circuit 104 is supplied to the primary coil 103. As a result, an alternating magnetic field is generated by the primary coil 103 within the depression 102 in the base case 101 of the charger 1.

This alternating magnetic field generates an induced electromotive force in the secondary coil 212 arranged in the base portion of the telephone case 201 of the radiotelephone 2. The alternating current

arising from this induced electromotive force is converted to direct current in an AC-DC conversion circuit 211. The direct current power outputted from the AC-DC conversion circuit 211 is supplied to the storage battery 210 and causes the battery to be charged. In this way, the storage battery 210 built into the radiotelephone 2 can be charged without being electrically connected to the charger 1, i.e., while in an electrically noncontacting state.

When charging is completed, or when it is necessary to take up the radiotelephone 2 from the charger for a call during charging, electromagnetic attraction caused by the electromagnetic induction between the primary coil 103 and the secondary coil 212 will be in effect if nothing is dealt with the charger, and will cause considerable force to be required to overcome this electromagnetic attraction in order to lift the radiotelephone 2 from the charger 1. In this case, switch 106 is operated, and by means of oscillating circuit control section 105, the supply of power to oscillating circuit 104 is halted, and oscillation in oscillating circuit 104 stops. By holding back the generation of magnetic flux in the primary coil 103, the electromagnetic attraction between the two coils can be checked and the radiotelephone 2 can be lifted with a normal amount of

force.

A first halt-signal generating circuit is provided in the control section 209 for supplying a halt signal in response to a signal generated by pushing specified keys of the console keyboard 203 on the radiotelephone 2 that is to be lifted. The halt signal delivered from the control section 209 is converted to a light signal by the light-emitting element circuit 213 and supplied from window 215 in the base portion of the telephone case 201. This light signal passes through window 108 provided in the base case 101 of the charger 1, is received by the light-receiving element circuit 107 and converted to an electrical signal. This electrical signal is transmitted to the oscillating circuit control section 105 and causes the oscillation of the oscillating circuit 104 to stop. Accordingly, if the user sets the key at the most accessible position when holding the radiotelephone as the specified key mentioned above, this key can be easily operated to halt oscillation in the oscillating circuit 104 when picking up the radiotelephone with one hand and enable easy lifting of the radiotelephone 2.

It is also possible to provide a second halt signal generating circuit in the control section 209 of the radiotelephone 2 for detecting an incoming call and producing a halt signal. In such a case, a halt signal

is produced automatically upon arrival of an incoming call. As in the case of the previously described halt signal, this halt signal is converted to a light signal in the light-emitting element circuit 213. The charger 1 receives the light signal at the light-receiving element circuit 107 which converts the light signal into an electrical signal. This electrical signal causes the oscillating circuit control section 105 to halt oscillation in the oscillating circuit 104. Accordingly, charging can be halted automatically when there is an incoming call to the radiotelephone 2 even during charging, and a user is enabled to easily lift the radiotelephone 2.

Although not shown in the figures, the previously described switch 106 may be constructed as a contact switch arranged on the inner bottom or inner side surface of the depression 102 such that the switch is turned on when the radiotelephone is placed within the charger. In this case, a construction is possible by which a slight tilting of the radiotelephone 2 within the depression 102 causes the contact switch to turn off, thereby halting oscillation of the oscillating circuit 104 and halting charging so that the radiotelephone can be lifted with a minimum of effort.

While the embodiment described hereinabove presents one example in which the present invention is

applied to a chargeable radiotelephone, the ideal application of the present invention is in applications of the apparatus of the present invention to any radio communication device which has a built-in chargeable battery and which may be needed for immediate use even during charging, for example, radio paging devices or radio communication devices such as transceivers.

The present invention may be summarized as follows:

By providing halting means for halting the supply of power to a primary coil provided in a charger of a noncontacting charging device, and by activating this halting means when the radio communication device is to be removed from the charger for use, electromagnetic attraction between the primary coil in the charger and the secondary coil within the radio communication device arising during charging of the radio communication device can be eliminated, thereby allowing lifting of the radio communication device with minimal effort and easing the handling of the radio communication device.

By automatically generating a halt signal when the console keyboard of the radio communication device is manipulated or when there is an incoming call to the radio communication device, it is possible to halt charging automatically or through an easy operation

when a call must be made or received during charging of the radio communication device, thereby further facilitating handling of the radio communication device upon call sending or call receiving.

By converting the halt signal to a light signal and supplying it to the charger, it is possible to transmit the halt signal from the radio communication device to the charger without direct contact.

The halting means for halting power supply to the primary coil may be constructed as a manually operated switch provided in the charger that cuts the power supply path to the primary coil, and merely operating this switch allows the radio communication device to be lifted with a minimum of effort.

It is to be understood, however, that although the characteristics and advantages of the present invention have been set forth in the foregoing description, the disclosure is illustrative only, and changes may be made in the arrangement of the parts within the scope of the appended claims.

CLAIMS

1. A charging system comprising a charger and a battery-equipped radio communication device for supplying electrical power to said battery while said charger and said radio communication device are in an electrically noncontacting state with respect to one another and for halting said supply of electrical power to said battery: said charger being provided with a primary coil and an alternating current supply means for supplying alternating current power to said primary coil; and said radio communication device being provided with a secondary coil for coupling electromagnetically with said primary coil, and charging-power supply means for supplying, as charging power, electrical power of an induced current produced in said secondary coil to said battery; said charger and said radio communication device being removably couplable to place said primary and secondary coils into electromagnetic coupling relationship with each other, characterized in that:

said radio communication device comprises a halt-signal-generating means for generating a halt signal in response to an incoming call to said radio communication device that commands a halt of the supply of alternating current power to said primary coil, during charging of said battery; and halting means for halting the supply of alternating current power to said primary coil in response to said halt signal.

2. A charging system according to claim 1, wherein said halt-signal-generating means further generates a halt signal in response to a manual input to said radio communication device that commands a halt of the supply of alternating current power to said primary coil.

3. A charging system according to claim 2, wherein said halt-signal-generating means comprises at least one console key responsive to said manual input for commanding a halt of the supply of alternating current power to said primary coil, and a manual-input-responsive halt-signal-generating circuit for producing said halt signal in response to a signal generated by key input to said console key.

4. A charging system according to claim 1, wherein said halt-signal-generating means comprises an incoming-call-responsive halt-signal-generating circuit for detecting an incoming call to the radio communication device and producing said halt signal in response to said incoming call.

5. A charging system according to claim 1 wherein said halting means comprises:

electrophoto converting means provided in said radio communication device for converting said halt signal to a light signal and supplying said light signal to said charger; and

photoelectric converting means and cut-off circuit means both provided in said charger, said photoelectric converting means receiving said light signal and converting said light signal to an electrical signal, and said cut-off circuit means cutting off a power supply to said primary coil in response to said electrical signal.

6. A charger for use in a charging system as defined in any of claims 1 to 5.

7. A radio communication device for use in a charging system as defined in any of claims 1 to 5.

8. An electrically noncontacting charging system for supplying, in an electrically noncontacting state, electrical power to a storage battery of a battery-equipped radio communication device substantially as described, with reference to the drawings.

9. A charger substantially as described, with reference to the drawings.

10. A battery-equipped radio communication device substantially as described, with reference to the drawings.

11. A noncontacting charging device for supplying, in a noncontacting state, electrical power to a storage battery of a battery-equipped radio communication device, comprising:

a charger having a primary coil and alternating current supply means for supplying alternating current power to said primary coil;

a secondary coil that couples electromagnetically with said primary coil, and charging-power supply means for supplying, as charging power, electrical power of an induced current produced in said secondary coil to said storage battery;

halt signal generating means for generating a halt signal that commands a halt of the supply of alternating current power to said primary coil; and

halting means for halting the supply of alternating current power to said primary coil in response to a halt signal;

said secondary coil, said charging power supply means, and said halt signal generating means being provided in said radio communication device.

12. A noncontacting charging device according to claim 11 wherein said halting means comprises:

electrophoto converting means provided in

said radio communication device for converting said halt signal to a light signal and supplying said light signal to said charger; and

photoelectric converting means for receiving said light signal and converting said light signal to an electrical signal, and cut-off circuit means for cutting the path of power supply to said primary coil in response to output of said photoelectric converting means, said photoelectric converting means and said cut-off circuit means being provided in said charger.

13. A device according to claim 11 or claim 12 wherein said halt signal generating means comprises at least one console key for commanding a halt of the supply of alternating current power to said primary coil, and a first halt signal generating circuit for producing said halt signal in response to a signal generated by key input to said console key.

14. A device according to claim 11 or claim 12 wherein said halt signal generating means comprises a second halt signal generating circuit for detecting an incoming call to the radio communication device and producing said halt signal.

15. A device according to claim 11 wherein said halting

means comprises a switch provided in the charger for cutting the power supply path to the primary coil by manual operation.

16. A noncontacting charging system for supplying, in a noncontacting state, electrical power from a charger to a storage battery of a battery-equipped radio communication device, in which:

the charger comprises a primary coil and an alternating current supply means for supplying alternating current power to said primary coil; and

the radio communication device comprises a secondary coil for coupling electromagnetically with said primary coil, and a charging-power supply means for supplying, as charging power, electrical power of an induced current produced in said secondary coil to said storage battery;

and in which a means is provided for halting the supply of alternating current power to said primary coil in response to operation of a halt signal generating means.

The Patent Office

21

INVESTOR IN PEOPLE

Application No: GB 9901521.6 **Examiner:** M J Billing
Claims searched: 1 to 16 **Date of search:** 10 February 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): H2H HBCD, HBCE, HBCF, HBCG, HBCH; H4L LECTX.

Int Cl (Ed.6): H02J 7/02; H04B 1/034, 1/38; H04M 1/72; H04Q 7/32.

Other: ONLINE - WPI.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB1180168	(GENERAL ELECTRIC) - see switch 22	11,16 at least
X	EP0357829A1	(TOPPAN MOORE) - column 5 lines 44-50, column 6 line 56 to column 7 line 4, column 10 lines 5-18	6,11,16 at least
X	EP0298707A2	(SEIKO) - column 4 lines 21-30	11,16 at least
X	JP040217824	(SHARP) - see switch 13	11,16 at least
X	SE920000554 & US5396538	(SAMSUNG) - column 4 lines 57-64, column 5 lines 62-68, column 9 lines 17-19 in US5396538	11,16 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.